



MOTION IMAGERY  
STANDARDS BOARD

**MISB EG 0810.2**

**Engineering Guideline**

**30 September 2010**

**Profile 2: KLV for LVSD Applications**

## 1 Scope

Large Volume Streaming Data (LVSD) / Wide Area Large Format (WALF) motion imagery systems are rapidly becoming one of the indispensable tools of persistent surveillance.

LVSD/WALF systems generally consist of an array of optical sensors, the outputs of which are fused to form composite images at motion imagery frame rates. The use of multiple sensors presents challenges for the transport and exploitation of the motion imagery, not least of which is accurately associating metadata with the output of each sensor.

The purpose of this Engineering Guideline (EG) is to describe the metadata elements and metadata structures necessary to support the characterization of LVSD/WALF data, especially for photogrammetry applications. In general, the metadata structures called out in this EG are defined in *MISB EG 0801: Profile 1: Photogrammetry Metadata Set for Digital Motion Imagery* [1] and *MISB EG 0806: Remote Video Terminal Local Data Set* [2]. It is assumed that this EG will be used in conjunction with MISB Standards 0102 [3], 0601 [4], and 0604 [5].

## 2 References

### 2.1 Normative References

The following documents are required to understand and properly implement this Engineering Guideline.

- [1] MISB EG 0801.2, *Profile 1: Photogrammetry Metadata Set for Digital Motion Imagery*, 3 December 2009
- [2] MISB EG 0806.3, *Remote Video Terminal Local Data Set*, 3 September 2009
- [3] MISB Standard 0102.8, *Security Metadata Universal and Local Data Sets for Digital Motion Imagery*, 20 May 2010
- [4] MISB Standard 0601.4, *UAV Datalink Local Data Set*, 20 May 2010
- [5] MISB Standard 0604.1, *Time Stamping of Compressed Motion Imagery*, 30 September 2010
- [6] MISB RP 0603, *Common Time Reference for Digital Motion Imagery Using Coordinated Universal Time (UTC)*, 10 August 2006
- [7] MISB Standard 0807.5, *MISB KLV Metadata Dictionary*, 20 May 2010
- [8] MISB EG 0701, *Common Metadata System: Structure*, 6 August 2007

## 2.2 *Informative References*

The following documents clarify and implement this Engineering Guideline:

- ANSI/SMPTE 298M-1997, *Universal Labels for Unique Identification of Digital Data*  
MISB RP 0605.2, *Inserting Time Code and Metadata in High Definition Uncompressed Video*,  
15 May 2008  
MISB RP 0608.1, *Motion Imagery Identification*, 13 December 2007  
MISB EG 0607.1, *MISB Metadata Registry and Processes*, 17 December 2008  
MISP 6.0, *MISB Motion Imagery Standards Profile v. 6.0*, 30 September 2010  
SMPTE 336M-2007, *Data Encoding Protocol Using Key-Length-Value*  
SMPTE 335M-2001, *Metadata Dictionary Structure*  
SMPTE RP 210.11-2007, *Metadata Dictionary Registry of Metadata Element Descriptions*

## 3 Sensor Element ID Key

### 3.1 *Basic Information*

Key Name:	Sensor Element ID
Key Number:	<b>06 0E 2B 34 01 01 01 01 0E 01 02 01 82 45 00 00</b>
Data Type:	UINT8
Data Format:	0 to 255
Length:	1 byte

### 3.2 *Purpose*

The fundamental distinguishing characteristic of an LVSD/WALF system is the simultaneous use of multiple sensor elements to produce a series of composite images. MISB EG 0801 [1] was written to support photogrammetric applications for systems involving a single sensor. The purpose of the Sensor Element ID Key is to allow for the identification of individual sensor elements in an LVSD/WALF system and to attribute to them their own photogrammetric data.

There are some elements of information that can be ascribed to an LVSD/WALF system rather than to the individual sensor elements. For some functions, it is necessary to describe the location of the system as if it were a single point in space. The attributes that describe an LVSD/WALF system especially the position of the system if it must be described as existing at a single point in space, characterize the LVSD/WALF *ensemble*. The Sensor Element ID value used to indicate information related to the ensemble will be zero (0).

Individual sensor elements within an LVSD/WALF system will be assigned unique, non-zero Sensor Element ID values. Each such element can then be identified by its Sensor Element ID value within an instance of the LVSD KLV Metadata LDS and the full range of metadata elements and metadata structures defined in EG 0801 can then be attributed to that element independent of the values assigned to other elements.

## 4 Sensor Element Description Key

### 4.1 Basic Information

The Sensor Element Description Key

Key Name:	Sensor Element Description
Key Number:	<b>06 0E 2B 34 01 01 01 01 0E 01 02 01 82 46 00 00</b>
Data Type:	ISO 7-bit String
Data Format:	ISO 7-bit String
Length:	40 bytes maximum

### 4.2 Purpose

The Sensor Element Description Key contains a description of an individual sensor element. For example, an EO sensor and an IR sensor might use the same optical train. Because the number and size of the pixels for the two sensors is different, the EO and IR sensor elements might be assigned different Sensor Element ID values. This would be the place to note such an occurrence.

This EG also assumes that Sensor Element ID values will be assigned *a priori*, and this key offers a way of explaining the scheme used to assign the Sensor Element ID values.

## 5 Version Key

The Version key indicates what version of this EG is being implemented.

Key Name:	Version
Key Number:	06 0E 2B 34 01 01 01 01 0E 01 02 05 04 00 00 00
Data Type:	UINT16
Data Format:	0x0 (for EG 0810.0; version EG 0810.1 would be 0x1, etc.)
Length:	2 bytes

See MISB EG 0801 [1] for further details.

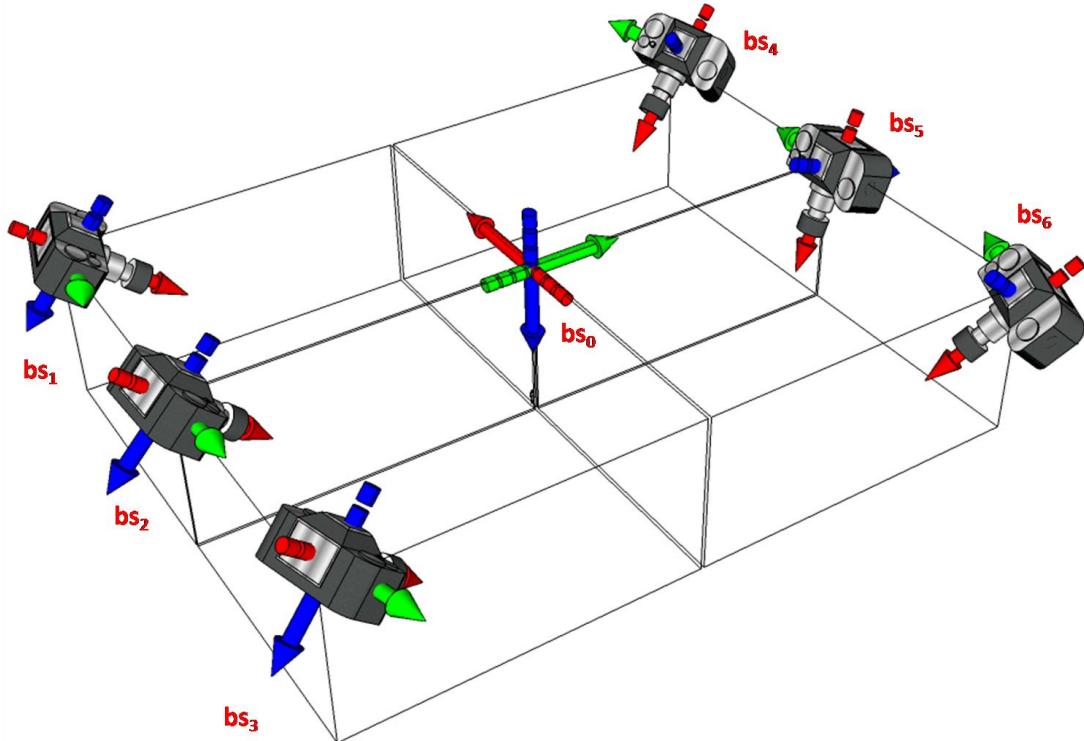
## 6 Photogrammetry Internal Parameters Boresight Truncation Pack

The purpose of the Photogrammetry Internal Parameters Boresight Truncation Pack is somewhat altered in this EG from its original purpose in EG 0801. For an instance of the LVSD KLV Metadata LDS with a Sensor Element ID of zero (0), the Boresight Truncation Pack describes the transformation from the platform origin to the sensor ensemble origin. For an instance of the LVSD KLV Metadata LDS with a non-zero Sensor Element ID, the Boresight Truncation Pack describes the transformation from the sensor ensemble origin to the specific sensor element origin.

Note that, in particular, to move from the platform co-ordinate system to the co-ordinate system of a particular sensor element, it is necessary to first transform from the platform co-ordinate system to the ensemble co-ordinate system (given by the ensemble Photogrammetry Internal

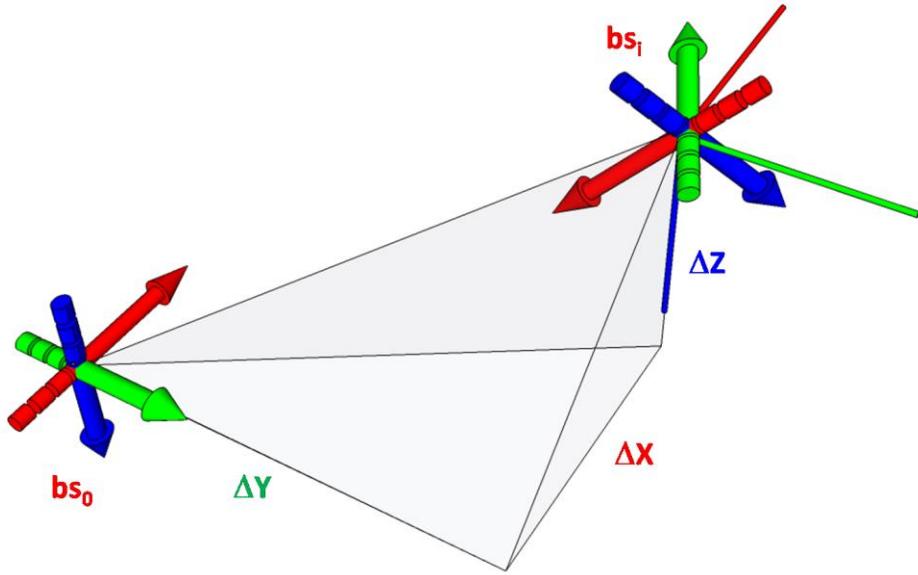
Parameters Boresight Truncation Pack, Tag 4 for Sensor Element ID zero (0)) and then from the ensemble co-ordinate system to that of the particular element (given by the Photogrammetry Internal Parameters Boresight Truncation Pack, Tag 4, associated with that Sensor Element ID).

Figure 1, below, gives an example of an array of six cameras arranged in two rows and three columns. The sensor ensemble is labeled at the center of the array as “bs<sub>0</sub>.” Each node contains the orientation of its co-ordinate system, where the x-axis is labeled in red, the y-axis is labeled in green, and the z-axis is labeled in blue. The values in each of the Boresight Truncation Packs 1-6 perform the transformation from the ensemble point, bs<sub>0</sub>, to each of the individual sensors, bs<sub>i</sub>.



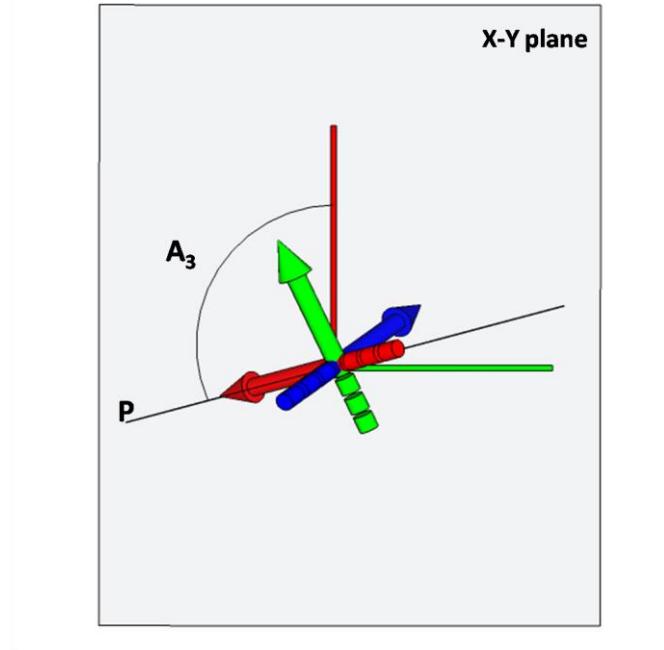
**Figure 1: Multi-sensor array relative to ensemble point**

These transformations are performed by first translating the origin of the ensemble point to the origin of the individual sensor. Figure 2, below, gives an example of the translation of the origin.



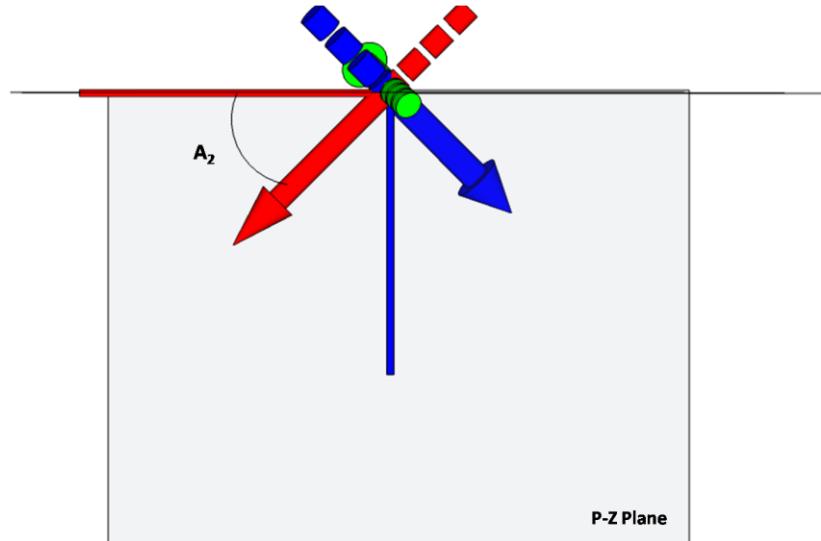
**Figure 2: Translation from ensemble point to the sensor location**

The sequential rotations are applied by first performing a rotation about the z-axis (blue), by an angle of  $A_3$ . The subscript on the angle is about the axis of rotation, where the x-axis rotation is labeled 1, the y-axis rotation is labeled 2, and the z-axis rotation is labeled 3.



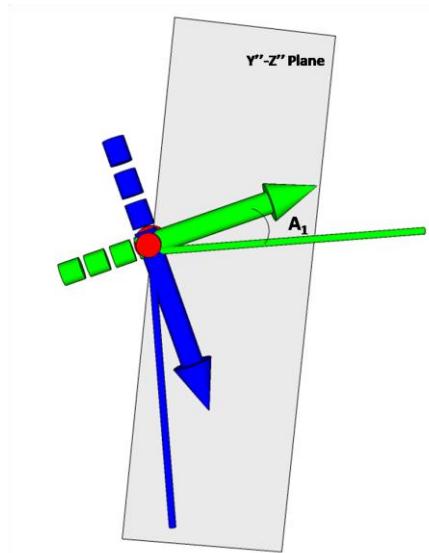
**Figure 3: Rotation about the z-axis**

This rotation about the z-axis rotated the original x-axis until it is parallel to the projection of the sensor's x-axis into the x-y plane, labeled in Figure 3 as “P.” The next rotation is about the once rotated y-axis (green) by an angle of  $A_2$ , which points into the page in Figure 4 below.



**Figure 4: Rotation about the once rotated y-axis**

This rotation will align the twice-rotated x-axis with the line-of-sight of the sensor. The final rotation is about the twice-rotated x-axis (red), by an angle of  $A_1$ .



**Figure 5: Rotation about the twice rotated x-axis**

This rotation is in the twice rotated Y-Z plane, which completed the triplet of rotations. All the rotations follow the convention where the positive angle is in the clockwise-direction when looking down the axis of rotation.

## 7 LVSD KLV Metadata LDS

Since each of the Truncation Packs and Local Data Sets defined in EG 0801 and included as elements of the LVSD KLV Metadata LDS already includes a POSIX Microsecond timestamp, no additional timestamp is required for the LVSD KLV Metadata LDS.

The first element of any instance of the LVSD KLV Metadata LDS shall be Tag 1, Sensor Element ID.

The second element of any instance of the LVSD KLV Metadata LDS shall be Tag 2, Sensor Element Description.

The third element of any instance of the LVSD KLV Metadata LDS shall be Tag 3, Version. For this initial version of EG 0810, the value assigned to Tag 3 shall be zero (0). For a future-incremented revision of this EG (0810.1), Tag 3 would have a value of one (1).

The last element in any instance of the LVSD KLV Metadata LDS shall be Tag 24, Checksum. The Checksum shall apply across the LVSD KLV Metadata LDS Key, the subsequent Length encoding, and all payload elements before Tag 22, Checksum.

Any LVSD KLV Metadata LDS Tag that refers to a Truncation Pack or LDS defined in MISB EG 0801 shall conform in all ways with the instructions given in EG 0801.

Beyond the five requirements defined immediately above, a valid instance of the LVSD KLV Metadata LDS may contain any combination of Tag 4 through Tag 23 in any order, so long as a Tag appears only once in an instance of the LVSD KLV Metadata LDS.

In Table 1 below, ‘V’ indicates an element of variable length, format, or units of measure.

**Table 1: LVSD KLV Metadata LDS**

Local Set Key		Name				
06.0E.2B.34.02.2B.01.01.0E.01.03.12.00.00.00		LVSD KLV Metadata LDS				
Constituent Elements						
Tag ID	Key	Name	Symbol/Notes	Units / Range	Format	Length (Bytes)
1	06.0E.2B.34.01.01.01.01.0E.01.02.01.82.45.00.00	Sensor Element ID	sensor_element_id	0..255	UNIT8	1
2	06.0E.2B.34.01.01.01.01.0E.01.02.01.82.46.00.00	Sensor Element Description	sensor_element_description	String	ISO 7-bit	40 max
3	06.0E.2B.34.01.01.01.01.0E.01.02.05.04.00.00.00	Version	version	0	UINT16	2
4	06.0E.2B.34.02.04.01.01.0E.01.03.02.06.00.00.00	Photogrammetry Internal Parameters Boresight Truncation Pack. <b>This Key defined in MISB EG 0801 but modified herein</b>	photogrammetry_boresight_tpack	V	V	V
5	06.0E.2B.34.02.04.01.01.0E.01.03.01.03.00.00.00	Photogrammetry External Platform Position Truncation Pack. <b>This Key defined in MISB EG 0801</b>	photogrammetry_postion_tpack	V	V	V
6	06.0E.2B.34.02.04.01.01.0E.01.03.01.05.00.00.00	Photogrammetry External Platform Velocity Truncation	photogrammetry_velocity_tpack	V	V	V

**Table 1: LVSD KLV Metadata LDS**

Local Set Key		Name				
06.0E.2B.34.02.2B.01.01.0E.01.03.03.12.00.00.00		LVSD KLV Metadata LDS				
Constituent Elements						
Tag ID	Key	Name	Symbol/Notes	Units / Range	Format	Length (Bytes)
		Pack. <b>This Key defined in MISB EG 0801</b>				
7	06.0E.2B.34.02.04.01.01.0E.01.03.01.04.00.00.00	Photogrammetry External Platform Orientation Truncation Pack. <b>This Key defined in MISB EG 0801</b>	photogrammetry_orientation_tpack	V	V	V
8	06.0E.2B.34.02.04.01.01.0E.01.03.01.08.00.00.00	Photogrammetry Platform Orientation Rate Truncation Pack. <b>This Key defined in MISB EG 0801</b>	platform_orientation_rate_tpack	V	V	V
9	06.0E.2B.34.02.04.01.01.0E.01.03.01.0A.00.00.00	Photogrammetry External Platform Position Truncation Pack. <b>This Key defined in MISB EG 0801</b>	photogrammetry_position_tpack	V	V	V
10	06.0E.2B.34.02.04.01.01.0E.01.03.01.0B.00.00.00	Photogrammetry External Platform Velocity Truncation Pack. <b>This Key defined in MISB EG 0801</b>	photogrammetry_velocity_tpack	V	V	V
11	06.0E.2B.34.02.04.01.01.0E.01.03.01.0A.00.00.00	Photogrammetry Sensor Absolute Orientation Truncation Pack. <b>This Key defined in MISB EG 0801</b>	sensor_absolute_orientation_tpack	V	V	V
12	06.0E.2B.34.02.04.01.01.0E.01.03.01.09.00.00.00	Photogrammetry Sensor Orientation Rate Truncation Pack. <b>This Key defined in MISB EG 0801</b>	sensor_orientation_rate_tpack	V	V	V
13	06.0E.2B.34.02.03.0B.01.0E.01.03.03.04.00.00.00	Photogrammetry External Parameters Correlation LDS. <b>This Key defined in MISB EG 0801</b>	photogrammetry_external_correlation_lds	V	V	V
14	06.0E.2B.34.02.04.01.01.0E.01.03.02.02.00.00.00	Photogrammetry Internal Parameters Image Size Truncation Pack. <b>This Key defined in MISB EG 0801</b>	photogrammetry_imagesize_tpack	V	V	V
15	06.0E.2B.34.02.04.01.01.0E.01.03.02.01.00.00.00	Photogrammetry Internal Parameters Focal Plane Truncation Pack. <b>This Key defined in MISB EG 0801</b>	photogrammetry_focalplane_tpack	V	V	V
16	06.0E.2B.34.02.04.01.01.0E.01.03.02.03.00.00.00	Photogrammetry Internal Parameters Radial Distortion Truncation Pack. <b>This Key defined in MISB EG 0801.</b>	photogrammetry_raddist_tpack	V	V	V
17	06.0E.2B.34.02.04.01.01.	Photogrammetry Internal	photogrammetry_tandecent_	V	V	V

**Table 1: LVSD KLV Metadata LDS**

Local Set Key		Name				
06.0E.2B.34.02.2B.01.01.0E.01.03.03.12.00.00.00		LVSD KLV Metadata LDS				
Constituent Elements						
Tag ID	Key	Name	Symbol/Notes	Units / Range	Format	Length (Bytes)
	0E.01.03.02.04.00.00.00	Parameters Tangential-Decentering Truncation Pack. <b>This Key defined in MISB EG 0801</b>	tpack			
18	06.0E.2B.34.02.04.01.01.0E.01.03.02.05.00.00.00	Photogrammetry Internal Parameters Affine Truncation Pack. <b>This Key defined in MISB EG 0801</b>	photogrammetry_affine_tpack	V	V	V
19	06.0E.2B.34.02.03.01.01.0E.01.03.03.05.00.00.00	Photogrammetry Internal Parameters Correlation LDS. <b>This Key defined in MISB EG 0801</b>	photogrammetry_internal_correlation_lds	V	V	V
20	06.0E.2B.34.02.04.01.01.0E.01.03.01.06.00.00.00	Slant Range Truncation Pack. <b>This Key defined in MISB EG 0801</b>	slant_range_tpack	V	V	V
21	06.0E.2B.34.02.04.01.01.0E.01.03.01.07.00.00.00	GPS DOP Truncation Pack. <b>This Key defined in MISB EG 0801</b>	gps_dop	V	V	V
22	06 0E 2B 34 02 0B 01 01 0E 01 03 01 0C 00 00 00	Point of Interest LDS. <b>This Key defined in MISB EG 0806.1</b>	poi_lds	None	N/A	V
23	06 0E 2B 34 02 0B 01 01 0E 01 03 01 0D 00 00 00	Area of Interest LDS. <b>This Key defined in MISB EG 0806.1</b>	aoi_lds	None	N/A	V
24	06.0E.2B.34.04.01.01.01.0E.01.02.03.01.00.00.00	Checksum; <b>This Key defined in MISB Standard 0601.2</b>	checksum	None	UINT16	2
25	06.0E.2B.34.02.2B.01.01.0E.01.03.03.0C.00.00.00	Range Image LDS; <b>This Key is defined in MISB EG 1002</b>		V	V	V
26	06.0E.2B.34.02.0B.01.01.0E.01.03.01.01.00.00.00	UAS Datalink Local Data Set; <b>This Key defined in MISB Standard 0601.4</b>		V	V	V
27	06.0E.2B.34.02.0B.01.01.0E.01.03.01.02.00.00.00	RVT Local Data Set; <b>This Key is defined in MISB EG 0806.3</b>	RVT KLV Dictionary	V	V	V
28	06.0E.2B.34.02.04.01.01.0E.01.03.03.14.00.00.00	Correlation Coefficient Variable Length Pack		V	V	V

## **8 Glossary**

ANSI	American National Standards Institute
EG	Engineering Guideline
KLV	Key-Length-Value Metadata
LDS	Local Data Set
LVSD	Large Volume Streaming Data
MISB	Motion Imagery Standards Board
RP	Recommended Practice
SMPTE	Society of Motion Picture and Television Engineers
WALF	Wide Area Large Format